Quorum Technologies

K775X Turbo Freeze Drier
Instruction Manual

For technical and applications advice plus our on-line shop for spares and consumable parts visit www.quorumtech.com

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C E Declaration:

This Equipment of this Design and manufacture and marked CE, conforms to the requirements of the European Directives EMC 89/336/EEC & LVD 73/23/EEC.

This Equipment will "fail safe" in the presence of excessive RF, Electrostatic Discharge or Mains Transients. While a loss of function could occur under extreme circumstances the Equipment's operation will be fully recoverable under normal operating conditions.

Mains Lead.

This Equipment must be Earthed and fitted with the correct lead for the country of operation. This will normally be achieved from the correct mains supply socket

Earth Connector.

This Equipment is normally supplied from 3-pin supply including Earth. If only 2-pin supply is available a separate Earth must be fitted. The supplementary Earth stud can be used to facilitate this requirement.

Output:

This is for the pump supply only and is at the mains voltage at a maximum of 8Amps.

Disclaimer

The components and packages described in this document are mutually compatible and guaranteed to meet or exceed the published performance specifications. No performance guarantees, however, can be given in circumstances where these component packages are used in conjunction with equipment supplied by companies other than Quorum Technologies Ltd.

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1. Description

To view a specimen in an Electron Microscope it needs to be free of water vapour. As the Microscope operates under a vacuum, the water would sublime and affect the performance.

If a specimen is allowed to dry in free air, it shrivels and distorts. One method to reduce this is to freeze dry the specimen. This works on the physics of what is known as triple point, where the three phases of liquid/gas/solid are in equilibrium. It is possible to go from the solid phase to the gas phase without the liquid and the associated shrivelling.

To do this, the specimen must initially be frozen; this in itself gives a further problem. If it is not frozen quickly enough, then ice crystals can form, and this also damages the specimen.
(A number of preparatory items of equipment are available for fast freezing. If the specimen is small enough, the plunging into liquid Nitrogen is sufficient.)

Having accomplished a suitably frozen specimen, we now want to go from the solid phase to the gas phase - for water this is at a vacuum. (There are several substances such as Carbon Dioxide where this occurs at atmospheric pressure.)

Even if we have overcome our first problem of fast freezing and reducing ice crystal damage, when we freeze dry at temperatures of say -60^{o}C, we can get ice re-crystallisation. This is typically -120^{o}C, however for relatively low-resolution work in E.M. this is not a problem.

To avoid this for delicate specimens, we need to dry at much lower temperatures, using an Instrument such as the Emitech K775X. However, this means the use of higher vacuums and the use of turbo pumps, also the drying times become very long - the lower the temperature then the lower the sublimation rate.

More recently it has been discovered that for small specimen, which can be frozen very quickly, or vitrified, there is little or no ice crystal structure, so no damage. However, as has been discussed, the drying times would be very long. This can be overcome by drying in steps, or, warming up continuously over a period of time. Commencing below the re-crystallisation point then, after the outer layer has been removed, at temperatures warmer than the re-crystallisation point. This is termed molecular distillation drying (M.D.D.). It has, in fact, been found that water has three frozen states: vitreous/cubic/hexagonal. Cubic is at -140^{o}C and hexagonal at -70^{o}C. The Emitech K775X fulfils the conditions for M.D.D. giving the flexibility for a series of temperature/time ramps for the drying protocol.

2. Installation

It is important that this equipment is installed and operated by skilled personnel in accordance with these instructions. Failure to do so may result in damage, and impair protection provided. 'If in doubt - ask'.

A suitable location should be provided for the unit - either operated on a bench or the recommended trolley. The total weight of the system is 42 Kg. The system operating environment ambient temperature range is 15°C - 25°C in a non-condensing relative humidity of not more than 75%. Sufficient ventilation is required This is particularly important if the instrument is to be left unattended when connected to an Liquid nitrogen Auto top up supply and positioning should be out of direct sunlight. The system is rated for continuous operation other than those supplies specified. See Section 2.3.

2.1 Preliminary Checks

Remove Instrument from packing and place on appropriate operational position. Carry out visual inspection for any signs of transit damage.

Remove Accessories Pack and check contents against K775X Accessories Pack Shipping List.

Ensure that all areas of the Instrument are free of loose packaging material. Check specifically the Instrument chamber, glass cylinder, and 'L' gaskets. (Do not use vacuum grease on gaskets.)

Where a vacuum pump has been supplied, carry out preliminary checks in accordance with manufacturers recommendations. (Refer to: Appendix 7.6 for pump plug wiring.)

NOTE: If you are using existing or alternative vacuum pump, and have any difficulty with connections, please advise.

2.2 Connections

Refer To: Appendix 7.1: Figure 1, Rear Panel Diagram.

Title	Function
Rocker Switch	Main power on to Instrument.
Power In	Main power inlet socket.
Pump Out	Power out to pump controlled by Instrument.
Gas Inlet (1) (FULL)	Process gas inlet supply from low-pressure regulator.
Gas Inlet (2) (RESTRICTED)	Process gas inlet supply from low-pressure regulator. (With inline restrictor.)
Auto Fill (Option)	Control to auto dewar fill unit
Fuse 1	Main.
Fuse 2	Heater Power Supply Fuse

NOTE: Any other items on rear panel not listed are for common manufacturing and are not available for this Instrument.

NOTE: A single phase AC supply with Earth is required - selected to the correct voltage for the country of operation. Either nominal 240V or nominal 120V. The voltage and frequency range is:

Nominal 240	Max. Current 10A	200 - 264V	47Hz To 63Hz
Nominal 120	Max. Current 20A	90V - 132V	47Hz To 63Hz

Carry out process gas connections to rear panel (Refer To: Appendix 7.1, Figure 1) with tubing and connectors provided. The connector is push-fit and will 'snap' into a locked position. It can be released by depressing the metal tongue. Dry Nitrogen gas is recommended at a nominal pressure of 5psi.

If only one process gas is used, the gas inlet 1 and gas inlet 2 have an external 'T' piece with restrictor in the gas inlet 2. Gas inlet 2 can then be used for the restricted venting at the end of a run.

If two process gases are used then gas inlet 1 is used for purging, and gas inlet 2 would **not** have the 'T' piece, but would have the restrictor and gas inlet 2 can then be used for the restricted venting at the end of a run.

For connection schematics, refer to Appendix 7.7

K775X Special Note: Nitrogen Gas for Purging etc.,

The K775X has a Liquid Nitrogen Dewar, which can be hand filled or an option is Auto Top Up from large supply Dewar. (Additional Auto Top Up information can be found in the 'Auto top up installation' Document upon request)

When Auto Top Up is used the Large Dewar provides Liquid Nitrogen and Nitrogen Gas. The Nitrogen Gas is needed for Purging and loading samples, and is generally used as the process gas for Purging and venting on both restricted and full vent. A 'T' piece connector being provided for this purpose.

Without Auto Top Up, it would be normal to supply Nitrogen gas for the above from a Gas cylinder with pressure regulator set at nominal 5psi (approx. 0.33bar), and this is the preferred supply.

The electrical input to the Instrument is made with the power lead provided. The Instrument connection is standard and the lead is supplied fitted with the appropriate plug for the country of operation.

Ensure the plugs are firmly located. Check the voltage is correct voltage for country of operation, which should correspond to the voltage label on the Instrument. The appropriate electrical supplies for countries are given in Appendix 7.5.

The vacuum connection is made by 1½ Metre length of vacuum hosing. This is a push-on fit to the Instrument. Ensure that this is firmly in place to the full length of the vacuum connector.

NOTE: If you are using existing or alternative vacuum pump, and have any difficulty with connections, please seek advice. An Oil Mist Filter with metal adapter should be fitted to outlet of vacuum pump (See Section 6). And a foreline trap is supplied to prevent back-migration of rotary pump oil into the K775X see the detailed instructions supplied with the foreline trap for its correct installation.

NOTE: As it is likely that the K775X will be operated continuously for long periods of time, it is recommended that an external vent be installed.

Check that the vacuum pump is filled with correct oil (See Section 6). If the vacuum pump is fitted

with an ON/OFF switch, ensure that it is left in the 'ON' position, as the Instrument will carry out required control.

2.3 Initial Operating checks

(These should be made having become familiar with the controls under Operation section)

ALL SUPPLIES ARE CONTINUOUSLY RATED.

Switch power on with rocker switch located on rear panel of Instrument. The integral neon should illuminate showing power to the Instrument.

The LED in the STOP switch should illuminate and the LCD should show the following display:

Press ENTER to load/change parameters
UP or DOWN arrow to use stored values
Press START to run when ready
Current Stage Temp. 22°C

Press the START switch, the LCD should show a display as below asking for the profile to be confirmed. The up or down arrows can be used to step through each segment. To cancel this and return to the main menu press the STOP key. If a particular parameter requires changing press the ENTER key which will run the normal set-up menu.

Confirm Temperature Profile
Segment 1
Time 0: 1: 0,End temp -120°C ,UP-Next
START-Accept, ENTER-Change, STOP-Cancel

If the profile is as desired then operate start switch again to confirm this, and start the sequence. The rotary vacuum pump and the turbo pump should both start. The main operating screen should be displayed as below.

current sequence operation or request			
Vacuum: 5x10-2 mbar		**Turbo Speed**	**23%**
End Tmp	**Target**	**Stage**	**Time Left**
-120°C	**-120°C**	**15°C**	**00:00:00**

Where the above says ***current sequence operation or request*** the display will either show which part of the sequence is currently in operation or a request for the user to perform an action, these will be described in detail shortly.

The vacuum reading will initially say 'Overrange' and will continue to do so until the vacuum achieves better than 1x10°mbar. From here downwards it will be in the form as above. The vacuum reading should achieve $5x10^{-1}$mbar within 2 minutes, and $1x10^{-2}$ in 3 minutes

The turbo speed is shown as a percentage from 0 to 100. Turbo should reach full speed 100% within 5 minutes of starting. The End temperature is the end temperature for the current profile segment. Initially when cooling down this will be the stage cool trip point.

The target temperature is the current target that the controller is trying to achieve. This temperature will move to achieve the ramp as defined in the profile and will converge at the end temperature at the end of the segment.

Stage is the current measured Stage temperature. When the unit has pump down for a few minutes press the STOP key. The pumps will stop and the instrument will vent to atmosphere and return to the main menu.

3. Operation

These are the controls by which the instrument is operated. Refer to Appendix 7.2 Front Panel Diagram

Front Panel Controls	
Start	The start button initiates the control sequence.
Stop	The stop button stops the current cycle when the instrument is running. Or cancels the current selection when editing values:- When running a protocol pressing the STOP button does the following: 1) Stops the rotary pump. 2) It also automatically stops the turbo pump (If the turbo pump is running). 3) Purges gas either restricted or unrestricted, as selected, and for the selected programmed time.
Up, Down.	These buttons either increment or decrement the value of the current variable when in the change parameters menu.
Enter	This button accepts the current value when in the change parameters menu.

3.1 Setting up operating parameters

There are a number of user programmable options that can be altered by the front panel keys. These are:-

Parameter	Allowable Values	Description
Turbo Disabled/enabled	0 = Disable, 1 = Enabled	When pumping the unit will either use the turbo pump or not depending on this value. The default value is 1
Number of Profile Segments	1-10	The number of segments that make up a profile run. The default is 10.
Profile Times/Temperatures	Time: Up to 99 Hours 59 Minutes Temperature from +40°C to --120°C	
Stage Cool Trip point	Temperature from +40°C to ---120°C	This is the temperature, which the stage must go below before the sample loaded. It applies to which ever setup is loaded.
Purge Type	0 = Unrestricted, 1= Restricted	This value determines which valve is used to vent the chamber to atmosphere. The default value is 1

When options are modified the software will by default save these so that they are in force the next time that the instrument is powered up. The software will also ask if they need to be saved in one of the ten stored programs.

3.2 To Check Or Modify Parameters

From the main menu press the ENTER to select the change parameters menu. The screen below should appear on the LCD

UP or DOWN key to ALTER
ENTER to accept, STOP to return
Variable Name Current Value

For simple numbers such as the turbo flag the value is shown along with the variable name. Where there are a number of values associated with a variable such as the profile segment data the UP or DOWN arrow key must be pressed to access the values.

3.3 To Check Modify The Temperature Profile.

First sketch the required profile on paper - See example below. The profile consists of a number of segments or times over which the temperature is either ramping up, ramping down, or remaining constant (soaking). There can be up to 10 segments, in this example there are 7.
NOTE: - On paper note the duration of each segment, and the end temperature of each segment.

Segment	End Temperature(^{O}C)	Duration (Hrs)
1	-120	1
2	-100	1
3	-80	1
4	-60	1
5	-20	1
6	+5	1
7	+25	5

NOTE: It is always good practise to have a final segment longer than is required so that the liquid nitrogen is allowed time to boil dry.

From the idle state press the ENTER key to change parameters and continue to press ENTER until *Number of Profile Segments* is shown. Change the number for the correct number of segments as required using the UP and DOWN arrow keys. Then press ENTER.

The display will show *Profile Times/Temperatures*. Press the UP or DOWN arrow keys to ENTER the profile edit menu. The display should be as below.

UP or DOWN key to ALTER
ENTER to accept, STOP to return
Profile Segment No. 1
Seg. Time: 0: 2: 0 End Temp -120°C

The cursor will flash over the hours setting for the first segment. If it is required to change this use the UP or DOWN arrow keys. When satisfied press the ENTER key and the cursor will move on to the minutes setting. Again use the UP or DOWN arrow keys as required to change. When ready press the ENTER key and the cursor will move to the end temperature of the segment use the UP or DOWN keys to change if required. It is recommended that the maximum temperature slope is 5°C per minute.

Now press the ENTER key again. The data will be shown for the next segment. Edit if required as above. Keep stepping through until all the segments have been programmed.

NOTE: It is not possible to jump out of the profile editing by pressing the STOP key once. It has to be pressed repeatedly to step through all of the segments.

NOTE: It is only necessary to enter the end temperature of the segment. The start temperature of the next segment is the end temperature of the previous segment. The start temperature of the first segment is the current stage temperature.

At the end of the parameter set-up the software will issue a prompt asking if it is required to save the settings. The instrument can store up to ten programs. Use the UP and DOWN arrow keys to select a program to save to and then ENTER, OR press another key (e.g. STOP) not to save.

If they are not saved they will still be used during the run and they will be restored after removing power from the instrument but when a stored program is loaded they will be lost.

NOTE: It is possible to cancel all stored profiles and return them to the factory defaults. This is done by holding the ENTER key when applying power to the instrument. (It is important to only hold the ENTER key).

To Stop A Profile Which Is Running.

Press the STOP button. The heaters will switch off, the turbo and rotary pumps will switch off and the unit will vent to atmosphere by whatever valve is selected.

3.4 Sequence

The sequence of events for a typical freeze drying run, assuming that the specimens have been prepared, and are being maintained under Liquid Nitrogen.

If a dewar auto fill unit are being used these should be inserted into the appropriate sockets on the rear panel prior to the mains power lead. Connect the mains power lead into the power inlet located on the rear panel. Connect the rotary pump power lead into the power outlet beside the inlet.

Now Switch On the instrument.

Switch the power on at the wall socket and switch the mains power switch located on the rear panel **'ON'**. The **STOP** light on the front panel will now light and the software will initialise. After a few seconds, the LCD display will change to show the main menu as previously described

including the current thermocouple temperature). The temperature profile parameters can now be changed if required, see 'To check or modify profile parameters'.

Close the chamber lid and press START. The screen will show the confirm profile display. If this is correct press the START key again to commence. The unit will pump down to achieve the vacuum trip point, which has a default of $1x10^{-3}$ mbar. When this vacuum has been reached the command line of the display will '**Start Cooling Now, START to continue'**.

Fill the Liquid Nitrogen dewar so that the stage is cooling ready for the specimen and press the START key.

If an auto fill unit is available, this should be enabled. If an auto fill unit is not being used, the dewar must be kept topped up to prevent the dewar from boiling dry. This will be done automatically if an auto fill unit is fitted.

Transfer The Specimen.

When the stage has cooled below the Stage cool trip point the display will show **Press ENTER when ready to Load sample.** Pressing the ENTER key will cause the software to stop the turbo and rotary pumps and open the full purge valve to flood the chamber with dry Nitrogen gas. The software allows 1 minute for the sample to be loaded, the time remaining is shown on the LCD screen. After this a sounder will operate to alert the user. The LCD screen also prompts the user to press the START button when ready to continue with the cycle.

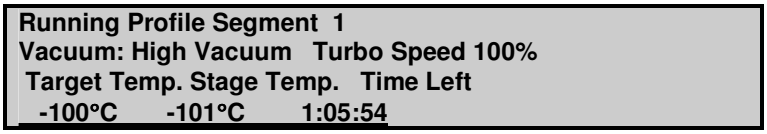
NOTE The default stage cool trip point is set at -120°C. The stage should reach this within about 30 minutes. The stage will ultimately cool to -140°C or colder.

Open the chamber lid and transfer the specimen holder containing the specimens to the chamber on the sprung loaded transfer rod. The holder will lock onto the button and allow the rod to be withdrawn. Close the cold trap over the specimen holder. Close the chamber lid and press the START button to continue.

Running the temperature profile

When the START button has been pressed, the software will enter the first segment of the profile. The software will calculate linear ramp to achieve the end temperature from the starting temperature in the given time. The starting temperature of the first segment is the current stage temperature. For all other segments it is the end temperature of the previous segment.

As the segment progresses the target temperature is changed to achieve the ramp. The LCD screen will look as below:



When the segment time has decreased to zero. The software proceeds to the next segment, until the programmed number of segments have been done.

When the last segment has completed the software will maintain the stage temperature at the end

temperature of the final segment, and the LCD screen will prompt the user when ready to unload the sample. This means that if the user is not around when the profile finishes the sample remains at a constant temperature and under vacuum until the START button is pressed.

NOTE: The liquid /Nitrogen dewar must not be allowed to boil dry at any time during the cycle (except at the end when the programmed temperature is above ambient.)

At the end of the profile (even if the last segment has been run) the stage will be maintained at the temperature that was entered for the final segment of the profile and maintain the vacuum. The display will show the prompt **Holding Temperature, Any key continues**. When ready to remove the sample Press any key. The pumps will stop and the instrument will enter a purge cycle for whatever type of purge has been selected (restricted or unrestricted).

If the final segment of the profile is running and the liquid Nitrogen has boiled dry then pressing the STOP key will bypass the holding temperature phase and allow the sample to be removed.

The chamber may now be opened and the specimen holder can now be removed with the transfer rod.

NOTE: - If the chamber is still under vacuum a further purge cycle can be initiated by pressing the STOP button when the instrument is idle (the main menu is displayed)

4. Drying Protocols

The following is only a brief outline and guide. For further details consult references - Section 8.

4.1 Unfixed Tissue

If a specimen has a naturally existing clean surface, then it can be quench frozen, freeze dried, then coated and examined in the SEM without any other fixation treatment.

4.2 Fixed Tissue

In general, fixed tissue shows better preservation than unfixed, the ice crystal damage being reduced. Fixed material is preferred unless the treatment causes artefacts or removal of significant components. A possible fixation is a low concentration of glutaraldehyde (1-2%) in cacodylate buffer, for some 4-6 hours, for small specimens ideally less than 2mm cubed with subsequent washing in distilled water for 1 hour to remove salt contamination.

It is recommended that surfaces are prepared prior to fixation and freeze drying, as it is difficult to fracture or cut freeze dried blocks without considerable damage due to their delicate nature. (other than where subsequent resin embedding and sectioning for TEM is envisaged). For observation, surface preparation is normally preferred by cutting with new clean single edge razor blade, with single 'slashing' stroke. (See Section 6)

4.3 Freezing and Transferring

Assuming sub cooled Liquid Nitrogen is being used, a range of techniques can be used with the accessories available. Specimens can be pre-frozen, then transferred to the Aluminium planchettes (See Section 6). The Aluminium planchettes should be under Liquid Nitrogen, as during transfer they will contain sufficient Liquid Nitrogen to give protection.

Specimens can also be mounted on the small copper discs (See Section. 6). They may be plunge frozen and transferred direct to the instrument, the copper mass maintaining frozen conditions during transfer. Or, they may be transferred to the aluminium planchette as described previously.

Wet specimens previously treated will adhere quite well to the copper disc. However, for the range of specimens, which can be encountered, adhesion may be a problem. In these cases, a very thin smear of O.C.T. Tissue Tek (See Section 6) on the surface of the copper disc will be found useful. This is liquid at room temperature, and forms a firm bond when frozen.

Cultures cells grown on flat substrates should be freeze dried with the substrate (e.g. A glass coverslip). These may then be transferred direct to the instrument, or again, using the Aluminium planchette.
NOTE: A preferred alternative to glass coverslips, which are fragile, are the thermanox type. They are a special solvent resistant plastic, which can be cut and trimmed with scissors (See Section 6).

Cells in suspension should be mounted before freeze drying, and freeze dried with their substrate. Again, pipetting on to a glass or thermanox coverslip, ensuring even spreading, should be satisfactory. In addition to the Aluminium planchettes and copper discs provided with the Instrument, a special transfer container is available. This is a cylindrical chamber, with well fitting lid, and a series of holes down the sidewalls to facilitate sublimed water vapour. The chamber is deep enough to carry over liquid nitrogen with the specimens, and may have advantages in certain applications. (See Section 6.)

4.4 Drying Periods

These vary considerably depending on specimen size and nature. The following will give an indication. It is generally suggested that all specimens should have a warming period either prior to mounting and coating for SEM, or resin embedding and sectioning for TEM.

Cultured Cells/Cells In Suspension	**Time**	**Temp.**
Constant	1 Hour	-120°C
Ramp	1 Hour	-120°C/-75°C
Constant	1 Hour	-75°C
Ramp	1 Hour	-75°C/-50°C
Constant	1 Hour	-50°C
Ramp	1 Hour	-50°C/+25°C
Constant	-	+25°C

Large Specimens Several mm Thick	**Time**	**Temp.**
Constant	8 Hour	-120°C
Ramp	1 Hour	-120°C/-75°C
Constant	16 Hour	-75°C
Ramp	1 Hour	-75°C/-50°C
Constant	16 Hour	-50°C
Ramp	1 Hour	-50°C/+25°C
Constant	-	+25°C

Small Pieces Tissue (2mm Cubed)	**Time**	**Temp.**
Constant	4 Hour	-120°C
Ramp	1 Hour	-120°C/-75°C
Constant	4 Hour	-75°C
Ramp	1 Hour	-75°C/-50°C
Constant	4 Hour	-50°C
Ramp	1 Hour	-50°C/+25°C
Constant	-	+25°C

5. Service and Maintenance

5.1 Maintenance

Procedure	Weekly/Monthly
Clean the chamber and the 'L' gaskets as required using a lint-free tissue and foam cleanser (See Section 6), or similar. **Do not use vacuum grease on 'L' gaskets.**	Monthly
Regularly clean and lightly polish the copper stage, and transfer container using Wenol polish. (See Section 6.)	Monthly
Check vacuum pump oil level. Change oil every 6 months using 1 litre of Supergrade 'A'. (See Section 6).	Monthly
Check Oil Mist Filter for saturation. Change every 6 months, or more regularly as required. (See Section 6.) (This is a disposable plastic filter and cannot be reactivated.) **NOTE:** With the K775X it is recommended that the pump vent is external.	6 Monthly
Check the sorbant charge the charge in the Forline Trap when the discolouration reaches the sorbant layer furthest from the port you must change the charge the time taken for this to occur is dependant on use A typical life is 6 months.	6 Monthly
Regularly inspect electrical power cords and plugs for general condition	Regularly

CAUTION:- Ensure mains electrical power is off during any maintenance and service activities.

5.2 Troubleshooting

Routine service should not be necessary. In the event of non-operation, carry out the following checks.

IMPORTANT:-Depending on nature of problem, disconnect power cord before carrying out any servicing activities.

1. Check power to instrument.

2. Check electronic supplies: The LED in the STOP switch should be on at power up.

3. Check fuses: Refer to: Appendix 7.2.

4. Check vacuum pump: local switch should be in 'ON' position.

5. Check chamber seating for vacuum leaks.

6. Check operating conditions of instrument controls.

7. Check that the LCD is showing the correct display.

In the event of all checks proving negative, please contact Quorum Technologies or your local distributor.
An advance delivery modular exchange service scheme is operated for the complete single module control electronics. This can be customer installed in accordance with Instructions provided.

CAUTION: -Ensure mains electrical power is off during any maintenance and service activities.

NOTE: Consumable items can be obtained from Quorum Technologies or approved distributor. Only Quorum Technologies recommended items should be used. For technical assistance and advice - contact Quorum Technologies.

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**If approved distributor not known - please contact Emitech direct for details.

6. SPARES AND ACCESSORIES

The following are available from Quorum Technologies, or your local distributor, and are featured in more detail in the current Quorum Technologies Consumables Catalogue. Copies can be sent on request

6.1 Spares for K775X Freeze Drier

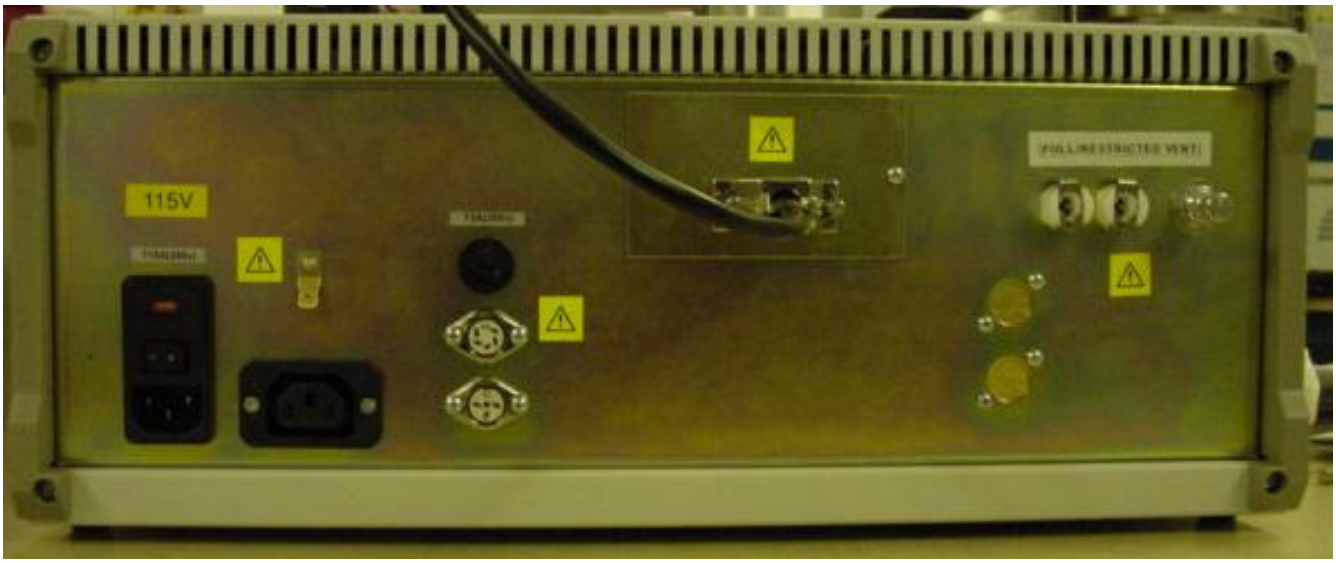
Description	Catalogue Number	Quantity
Aluminium Planchettes	P8004	Pkt.100
Copper Discs	D5611	Pkt.10
Desiccant Containers & Caps 9ml.	D5612	Pkt.20
Glass Cylinder 6"	G6260	Each
'L' Gaskets To Suit	G6261	Pair
Oil Mist Filter	O7803	Each
Polystyrene Cups	P8002	Pkt.25
Supergrade 'A' Rotary Pump Oil	O7802	1 Litre

6.2 Useful accessories for the K775X Freeze Drier

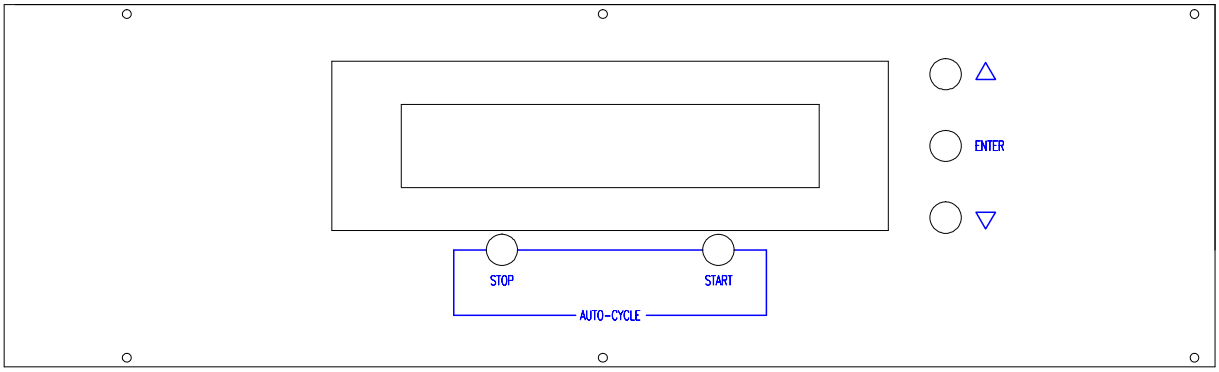
Description	Catalogue Number:	Quantity
Foam Cleanser - Anti Static	C5402	200g. Can
Glass Coverslips 22 x 22mm	C5413	Box 100
Glass Coverslips 16mm.DIA.	C5414	Box 100
Single Edge Razor Blades S/S	R8401	Box 100
Single Edge Razor Blades C/S	R8402	Box 100
Thermanox Coverslips 10.5x22mm.	C5415	Box 100
Thermanox Coverslips 22 X 60mm	C5416	Box 100
Thermanox Coverslips 15mm. Dia	C5417	Box 100
Tissue Tek O.C.T.	A5007	110ml.

7. Appendices

7.1 Rear Panel Drawing



7.2 Front Panel Drawing



7.3 Fuse Listings

Fuse Listing - 240 Volts

Title	Rating	Function
Fuse 1 (1.25" X 0.25")	**T 10 Ceramic**	**Main Power**
Fuse 2 (1.25" X 0.25")	**T 1A Ceramic**	**Heater Power Supply**

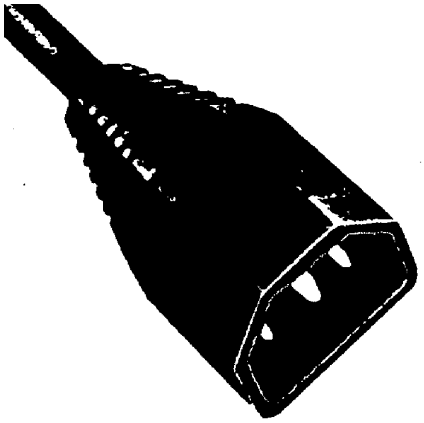
Fuse Listing - 120 VOLTS

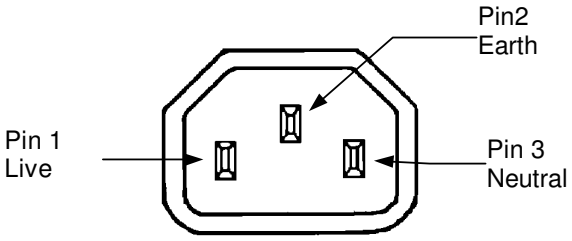
Title	Rating	Function
Fuse 1 (1.25" X 0.25")	**T 15 Ceramic**	**Main Power**
Fuse 2 (1.25" x 0.25")	**T 2A Ceramic**	**Heater Power Supply**

T10A is preferred fuse.
May be substituted for 10A Slo-Blo Ceramic Fuse - Non preferred..
Fuse Standard IEC 127, CEE4.
Fuse Standard CSA C22.2/UL 198G *
Replacement fuses can be supplied by QUORUM, or the approved distributor.**

Quorum Technologies Ltd
South Stour Avenue, Ashford, Kent, England, TN23 7RS.
Tel: 01233 646332 (+44 1233 646332)
Fax: 01233 640744 (+44 1233 640744)
** If an approved distributor is not known - please contact Quorum direct for details.

7.4 Pump Plug wiring





	UK and Europe	U.S.A. and Canada
Pin 1 (Live or Hot)	Brown	Black
Pin 2 (Earth)	Green / Yellow	Green
Pin 3 (Neutral)	Blue	White

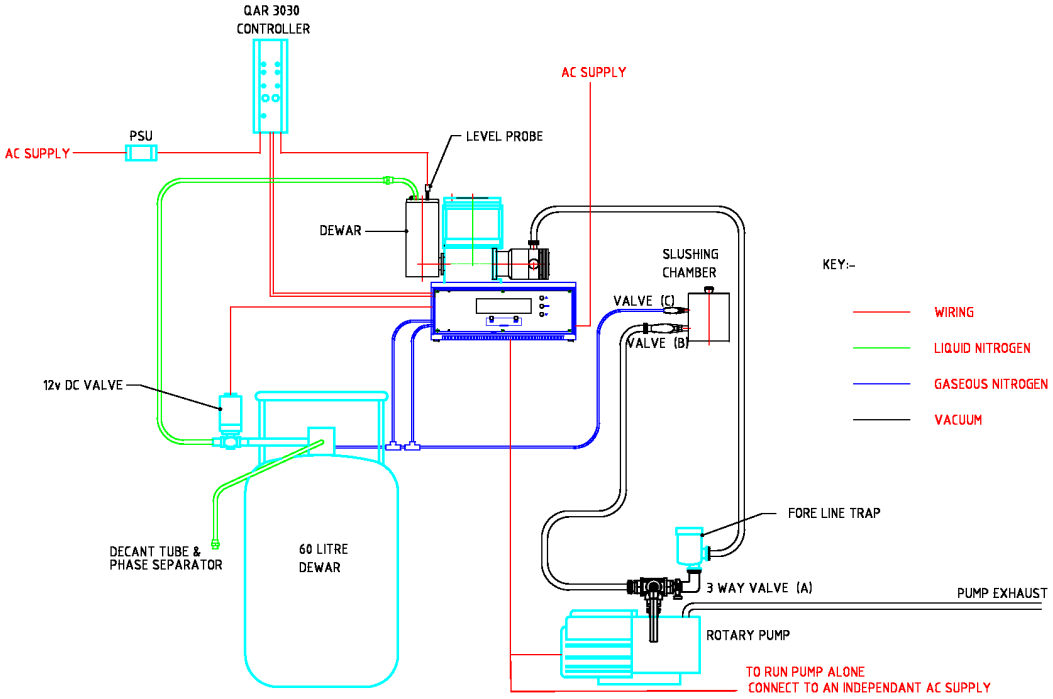
7.5 Table of Time/Temperature Profiles

Segment Number		Default Settings	Setup									
			1	2	3	4	5	6	7	8	9	10
1	End Temperature	-120°C										
	Time (minutes)	00:10										
2	End Temperature	-100°C										
	Time (minutes)	00:10										
3	End Temperature	-80°C										
	Time (minutes)	00:10										
4	End Temperature	-80°C										
	Time (minutes)	00:10										
5	End Temperature	-60°C										
	Time (minutes)	00:10										
6	End Temperature	-40°C										
	Time (minutes)	00:10										
7	End Temperature	-20°C										
	Time (minutes)	00:10										
8	End Temperature	0°C										
	Time (minutes)	00:10										
9	End Temperature	+20°C										
	Time (minutes)	00:10										
10	End Temperature	+40°C										
	Time (minutes)	01:00										

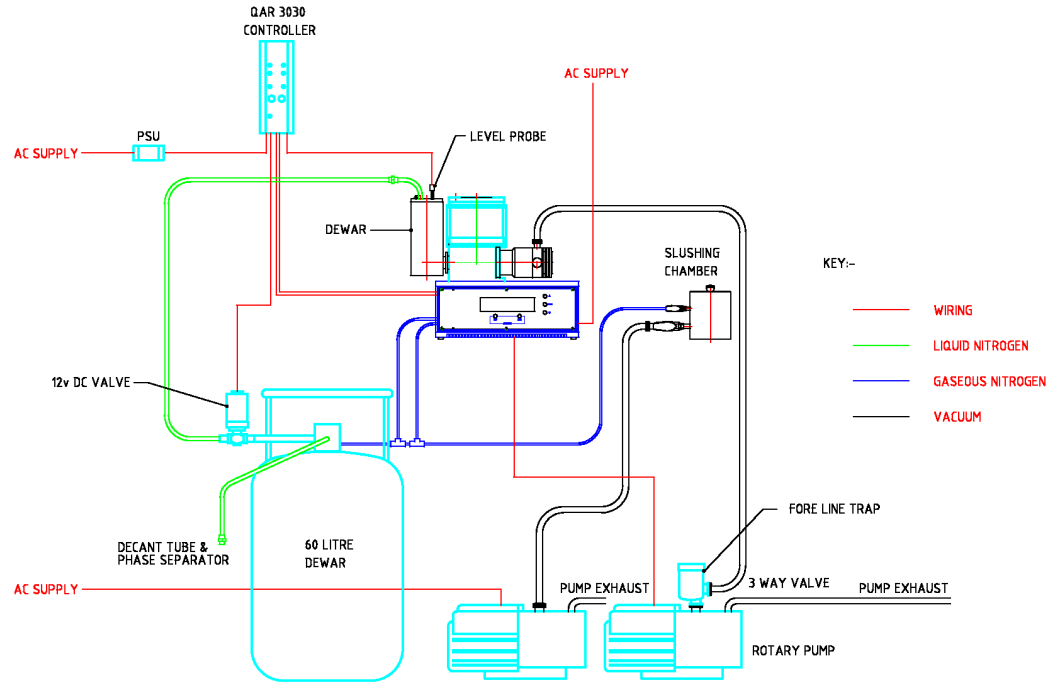
7.6 Worldwide Electrical Supplies

Country	AC Volt/Freq.
Brazil	220V/60Hz
Canada	115V/60Hz
France	220V/50Hz
Germany	220V/50Hz
India	230V/50Hz
Ireland	230V/50Hz
Israel	230V/50Hz
Italy	220V/50Hz
Korea	115V/60Hz
Japan	100-200V/50Hz-60Hz
Netherlands	220V/50Hz
Norway	220V/50Hz
Pakistan	230V/50Hz
Portugal	220V/50Hz
Scandinavia	220V/50Hz
Singapore	240V/50Hz
Spain	220V/50Hz
Taiwan	220V/60Hz
Turkey	220V/50Hz
United Kingdom	220-240V/50Hz
United States of America	115V/60Hz

7.7 *Connection Schematics*



Single pump system



Twin pump system

8. References

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2. SANDBERG, P.A. (1970).

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3. SJOSTRAND, F.S., (1967).

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5. KARNOVSKY, M.J. (1965).

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Publication No. P1/1
(AVAILABLE ON REQUEST.)

Safety information for the return of Preparation Equipment and Accessories.

General Introduction

The employer (user) is responsible for the health and safety of his employees. This also applies to all those persons who come into contact with the Preparation Equipment and Accessories either at the user or manufacturer's premises during repair of service. The contamination of Preparation Equipment and Accessories has to be declared and the Health and Safety Declaration form completed.

Health and Safety Declaration

Those persons carrying out repair or service have to be informed of the condition of the components. This is the purpose of the 'Declaration of Contamination of Preparation Equipment and Accessories'.

Despatch

When returning equipment the procedures set out in the Operating Instructions must be followed. For example:

- Drain the vacuum pumps.
- Neutralise the flushing with gas.
- Remove filter elements.
- Seal all outlets.
- Pack glass components safely.
- Pack loose attachments securely for example stages.
- Seal in heavy-duty polythene or a bag,
- Despatch in suitable transport container.

Return Address:
F.A.O.: The Service Manager,
Quorum Technologies Ltd,
South Stour Avenue,
Ashford,
Kent. TN23 7RS.

Declaration of Contamination of Preparation Equipment and Accessories.

The repair and/or service of Preparation Equipment and Accessories can only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer reserves the right to refuse acceptance of consignments submitted for repair or maintenance work where the declaration has been omitted.

This declaration may only be completed and signed by authorised and qualified staff.

1. Description of component	**2. Reason for return**:
- Equipment type/model: _____ - Code No:. _____ - Serial No.: _____ - Invoice No. (if known) _____ - Delivery Date.: (if known)_____	_____ _____ _____ _____ _____
3. Equipment condition - Has the equipment been used? Yes/No - What type of operating medium was used? _____ - Is the equipment free from potentially harmful substances? Yes/No (If Yes go to Section 5) (If No go to Section 4)	**4. Process related contamination of Equipment/ Accessories.** - Toxic Yes/No - Corrosive Yes/No - Explosive* Yes/No - Microbiological* Yes/No - Radioactive* Yes/No - Other harmful substances Yes/No

* We will not accept any Equipment/Accessories which have been radioactively, explosively, or microbiologically contaminated without written evidence that such Equipment/Accessories have been decontaminated in the prescribed manner.

Please list all harmful substances, gases and dangerous by-products which have come into contact with the Preparation Equipment and Accessories.

Trade name Product name Manufacturer	Chemical name and symbol	Danger class	Precautions associated with substance.	First aid measures in the event of an accident.
1.				
2.				
3.				
4.				
5.				

5. Legally Binding Declaration.

I hereby declare that the information supplied on this form is complete and accurate. The despatch will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of Organisation: _____

Address: _____

_____ Post Code: _____

Tel.: _____ Fax.: _____

Name: _____ Job Title: _____

Date: _____ Company Stamp: _____

9. DOCUMENT HISTORY

Issue	Date	Details	Revised By
1	10/10/2000	Initial Issue for new instrument	DJR
2	12/09/2002	Page 1 Photo added	RIS
3	11/12/2002	Changes to text	RIS
4	23/04/2003	Changes to text	RIS
5	30/12/2003	Revision of layout	JB
6	1/4/2009	P11 30min was 20 - New heater plate	PRM
7	26/05/2009	To include connection schematics	JRM